

# PATENT SPECIFICATION



Application Date : May 5, 1931. No. 13,307 / 31.

**370,687**

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## PROVISIONAL SPECIFICATION.

### Improvements in or relating to Electric Water Heating Devices.

I, HARRY WILLIAM DARBY, Builder, of Tudor House, High Street, Eltham, S.E.9, a subject of the King of Great Britain, do hereby declare the nature of this invention to be as follows:—

This invention relates to electric water heating devices and has for its chief object to provide a compact and serviceable heating device which will give a practically instantaneous supply of hot water when required for domestic or similar purposes.

A further object of the invention is to provide an improved switch device constructed in such a manner so as to ensure that the water shall flow through the device before the electric current supply is turned on and so as to ensure that the electric current supply be turned off before the flow of water through the device ceases.

According to the invention the device comprises a tortuous or elongated passageway providing a relatively long path along which the water flows and an electric heating element arranged in said passageway and freely exposed to the water flowing therein. The passageway may conveniently be formed in a plate of electric insulating material which is preferably formed of or moulded from the material known under the registered Trade Mark "Bakelite" or similar synthetic resin material. It is preferred to employ two of such plates having tortuous passages the plates being secured together with preferably a sheet of rubber contacting with each face of the plates and with a sheet of synthetic resin material arranged between the sheets of rubber so as to separate the tortuous passages in each plate, the water being permitted to flow from one plate to the other only through the medium of apertures arranged in the sheets of material interposed between the two plates. It is preferred to arrange the flow of water in such a manner that it enters one plate and passes through the passageway in the plate which passageway terminates at about the centre of the plate from whence the water passes through the apertures in the sheets of

material into the adjacent plate and from the centre of that plate the water flows around the passageway to the outside. It is preferred to form the two plates with bosses which are arranged so that when the two plates are secured together for example by means of screws, clamps, or the like the bosses register with one another. One of the bosses is connected to the cold water supply while the other boss is provided with a jet or the like from which the hot water issues. The sheets of material interposed between the two plates may serve to prevent a through flow of cold water through the two bosses. The outer surface of the two plates may be conveniently reinforced by the provision of webs or the like. The plates may be of any suitable form for example circular or rectangular and in the case of a circular plate the passageway would be in the form of a spiral depression and in the case of rectangular plates the passageway would be in the form of a substantially rectangular spiral formation. It is preferred in each plate to provide two electric heating elements the two heating elements being spaced apart from one another by means of a number of lugs or other projections located along the lengths of the passageways. Alternatively, a single heating element may be employed. It is preferred that the two heating elements be fed with current at two points. The electric heating elements may commence for example in the region of the water inlet in one plate and at the water outlet in the other plate and may terminate in each plate just prior to the apertures where the water passes from one plate to the other plate. A suitable terminal may be mounted for example on one side of each plate to which the positive side of the electric current supply may be connected. Embedded in each plate is a strip of copper or other electric conducting material which is arranged so as to conduct the current supply to two pairs of terminals in each plate to which the ends of the electric heating elements are connected. The negative side of the current supply is fed to the electric heating element substantially midway

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between their lengths. A negative terminal is provided adjacent the positive terminal on each plate and each negative terminal is associated with a strip of copper or other electric conducting material embedded in each plate and which each have a pair of terminals to which the electric heating elements are connected. The two plates provided with the electric heating element as aforesaid when secured together by means of screws or the like with the sheets of material between them form a water-tight compartment the water passing into one plate on one side and emerging from the other plate on the other side. The electric heating elements in each plate are preferably connected together in parallel for which purpose the two negative terminals on the plates and the two positive terminals are interconnected by metal strip or wire. The terminals are preferably enclosed by means of a detachable box or structure of insulating material. Water is permitted to flow through the two plates upon manipulation of a suitable cock which is so associated with a switch device that the water is caused to flow before the electric current supply is turned on and that the electric current supply is turned off before the flow of water ceases. The cock is preferably in the form of a plug or quick screw cock arranged in a pipe line connecting the device to the main water supply. The handle of the cock or another part of the cock may be provided with a gravity controlled mercury switch. This switch is preferably in the form of a sealed glass container having two terminals which may be connected in the positive side of the electric current supply. Contact is made through these two terminals by means of mercury contained in the glass container. When the cock is in its open position in which position water is permitted to flow through the heating device the mercury in the container bridges the two terminals so

that current may flow in the circuit. When, however, the cock is turned off the mercury flows to one end of the container and opens the circuit through the two terminals. The negative side of the electric current supply is opened and closed preferably by means of a brush contact switch comprising a movable brush and a fixed brush. The movable brush is preferably mounted upon a part of the cock so that it may be moved into contact with the fixed brush when the cock is moved into the open position to close the negative side of the circuit. The switch is also so arranged that the mercury gravity switch is opened first when the cock is turned off so that any sparking which may occur arises in the mercury switch and not between the brushes of the contact switch. In order to avoid any electrification of the water due to its contact with the electric heating elements it is preferred to arrange the pipe line connecting the device with the main water supply so that each part of the pipe line is in electric contact so that the water flowing through the device may be earthed. If, however, it is not possible to maintain each part of the pipe line in electrical contact due for example to the provision of washers or the like a separate earth connection may be made.

By the employment of the construction according to the invention it is possible to obtain a practically instantaneous supply of hot water. Due to the switching arrangement the water must flow through the device before current is supplied to the heating elements thereby avoiding overheating of the elements and subsequent damage to the plates.

Dated this 5th day of May, 1931.  
 HASELTINE, LAKE & Co.,  
 28, Southampton Buildings, London,  
 England, and  
 19-25, West 44th Street, New York,  
 U.S.A.,

Agents for the Applicant.

#### COMPLETE SPECIFICATION.

#### Improvements in or relating to Electric Water Heating Devices.

I, HARRY WILLIAM DARBY, Builder, of Tudor House, High Street, Eltham, S.E.9, a subject of the King of Great Britain, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to electric water

heating devices and has for its chief object to provide an improved water heating device of a compact construction which will give a practically instantaneous supply of hot water when required for domestic or similar purposes.

A further object of the invention is to provide an improved switch device constructed in such a manner as to ensure

that the water shall flow through the device before the electric current supply is turned on and to ensure that the electric current supply be turned off before the flow of water through the device ceases.

According to the invention the device comprises a substantially flat plate having a tortuous or elongated passageway or channel providing a relatively long path in which the water is adapted to flow and an electric heating element arranged in said passageway and freely exposed to the water flowing therein. The passageway may conveniently be formed in a plate of electric insulating material which is preferably formed of or moulded from the material known under the registered Trade Mark "Bakelite" or similar synthetic resin material. It is preferred to employ two (or more) of such plates having tortuous passages the plates being secured together with preferably a sheet of rubber or other suitable material such as asbestos contacting with each face of the plates and with a sheet of synthetic resin material arranged between the sheets of rubber so as to separate the tortuous passageways in each plate, water being permitted to flow from one plate to the other only through the medium of apertures arranged in the sheets of material interposed between the two plates. It is preferred to arrange the flow of water in such a manner that it enters one plate and passes through the passageway in that plate which passageway terminates at about the centre of the plate from whence the water passes through the apertures in the sheets of material into the adjacent plate and from the centre of that plate the water flows around the passageway to the outside.

It is preferred to provide two heating elements in the passageway in each plate which are fed with an electric current at two points. A valve or cock is preferably provided for controlling the flow of water through the plates which is so associated with a switch device that water is caused to flow through the plates before the electric current supply is turned on and that the electric current supply is turned off before the flow of water ceases. Means may also be provided for permitting a flow of cold water through the heating device.

In order that the said invention may be clearly understood and readily carried into effect the same will now be more fully described with reference to the accompanying drawings which illustrate the invention as applied by way of example to a heating device employing two plates having tortuous or elongated

passageways and in which:

Figure 1 is an elevation of one of said plates showing the said passageway;

Figure 2 is an outside elevation of the plate shown in Figure 1;

Figure 3 is a horizontal section taken along the line 3-3 of Figure 1 and showing two plates clamped together.

Figure 4 is a view similar to Figure 3 taken along the line 4-4 of Figure 1,

Figure 5 is an elevation of a preferred form of means for connecting the heating device to the water supply and illustrating a valve or cock associated with a switch device,

Figure 6 is a view similar to Figure 5 but showing a further form of switch device; and

Figure 7 illustrates in rear perspective the valve or cock shown in Figure 5 provided with mechanism for permitting a flow of cold water.

Referring now more particularly to Figures 1 to 4 of the accompanying drawings, reference numerals 6 and 7 illustrate two substantially rectangular shaped plates preferably moulded from synthetic resin material and each having an elongated or tortuous passageway 8 on its inner surface. Each plate is provided with a boss 9 to which a suitable connecting member 10 hereinafter more fully referred to, is applied for the purpose of supplying cold water to the passageways. The two plates are clamped together by clamping screws or bolts 11 the passageway in one plate being separated from the passageway in the other plate by the interposition of sheets of rubber or other resilient material 12 between which is arranged a sheet of substantially inflexible material 13 such as a sheet of synthetic resin material.

The water enters one of the plates for example the plate 6 through its boss 9 and flows around the elongated or tortuous passageway to the centre of the plate from which it passes to the plate 7 through apertures 14 (Figure 3) formed in the sheets 12 and 13. The water then flows from the centre of the plate 7 around the elongated or tortuous passageway in that plate and then flows out through the boss 9 on the plate 7. The outer surfaces of the two plates are reinforced by the provision of webs or the like 15 shown in Figure 2. A single heating element may be arranged in each passageway in each plate although it is preferred to employ two or more heating elements in each passageway of each plate fed with an electric current at two points. The electric heating elements in each plate commence in the region of the water inlet in the plate 6 and at the water outlet in

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the other plate 7 and may terminate in each plate just prior to the point where the water passes from one plate to the other plate. Embedded in each plate is 5 a strip of copper or other electric conducting material 16 which is arranged to conduct the current supply to two pairs of terminals 17 and 18 in each plate to which the ends of the electric heating 10 elements not shown are connected. The strip 16 is connected to a terminal 19 mounted on one side of the plate 6 to which for example the positive side of the electric current supply is connected. 15 The negative side of the current supply is fed to the electric heating elements substantially midway between their lengths. A negative terminal 20 is provided adjacent the positive terminal 19 on the plate 6 and such negative terminal 20 is connected to a strip of copper or other electric conducting material 21 embedded in the plate. Connected to the strip 21 is a pair of 20 terminals 22 to which the electric heating elements are connected. The electric heating elements as aforesaid are arranged in the passageway 8 and are freely exposed to the water flowing 25 therein the two heating elements being separated one from the other by means preferably of a continuous ridge or projection 23 or a series of projections arranged along the length of the passageway. The plates 6 and 7 with the electric 30 heating elements arranged therein as aforesaid when secured together by means of the screws or bolts 11 with the sheets 12 and 13 between them form a watertight compartment the water passing 35 into one plate on one side and emerging from the other plate on the other side. The electric heating elements in each plate are preferably connected together 40 in parallel for which purpose the two negative terminals on the plates 6 and 7 and the two positive terminals are interconnected in any suitable manner. The terminals 19 and 20 are preferably 45 connected together 50 enclosed by means of a detachable box or structure of insulating material not shown. As aforesaid water is caused to flow through the two plates through the connecting member 10 which has an 55 annular depression 24 to permit the free flow of water from the member to the plate 6. The connecting member 10 also has another annular depression 25 for permitting the free flow of water from the 60 plate 7 to the outlet 26 to which is connected a suitable form of jet or the like. The water is supplied to the member 10 under the control of a suitable valve or cock 27 Figure 5 which is provided in a 65 pipe line 28 connected with the main water supply by means of a connection 29. The manipulating handle 30 of the cock 27 is so associated with a switch device 31 that the water is caused to flow through the plates 6 and 7 before the electric 70 current supply is turned on and is also so arranged that the electric current supply is turned off before the flow of water ceases. The cock 27 is preferably in the form of a plug or quick screw 75 cock which may be completely closed or fully opened within a range of say 180°. The switch device 31 is pivotally mounted at 32 upon the pipe line 28. It is preferred that both the negative and positive lines of the current supply be 80 opened or closed upon manipulation of the handle 30. For this purpose two gravity controlled mercury switches are arranged inside the device 31 which latter may be in the form of a casing of synthetic resin material. One of the said mercury switches is arranged in the negative side 85 while the other mercury switch is arranged in the positive side. These mercury switches may each be of the usual known type in the form of a sealed glass container having two terminals, contact being made through the terminals when the glass container is tilted causing the mercury to bridge the terminals. In the position shown in Figure 5 the cock 27 in its closed position and the switch device 31 is held in the position shown by means of an arm 35 mounted upon and 90 adapted to rotate with the valve spindle. When the handle 30 is moved in the direction of the arrow to open the cock 27 the arm 35 moves out of contact with the switch device 31 permitting a compression spring 33 to move the switch device 31 into the dotted line position. This tilting of the device 31 causes the mercury in the switches to bridge the 95 terminals and so close the circuit. When however the handle 30 is moved in the opposite direction and just prior to the position which it occupies when the valve 100 is fully closed the arm 35 contacts with the switch device 31 and moves the 105 device into a position to open the electric circuit.

In Figure 6 the switch device 31 is pivotally mounted upon a lug 32a depending from the cock 27. In the position shown the cock 27 in its closed position and the switch device 31 is held in the position shown by means of a tension spring 33a which maintains an abutment 110 34 on the device 31 in contact with the casing of the cock 27. The handle 30 is associated with a lug or finger 35a which when the handle 30 is moved in the direction of the arrow into a position to 115 open the cock engages the device 31 to 120 open the cock.

move it into the dotted line position causing the mercury in the switches to bridge the terminals and so close the circuit. When however the handle 30 is moved in the opposite direction the device 31 is moved into the full line position shown due to the action of the spring 33a thus opening the electric circuit. It will be appreciated that the device 31 moves into the position to open the circuit before the handle 30 is in the position shown thus causing the electric circuit to be opened before the water supply ceases.

Figure 7 illustrates the valve or cock 27 shown in Figure 5 provided with mechanism which may be employed for permitting the flow of cold water through the heating device. Pivotaly mounted upon pins 38 at the rear of the valve 20 casing 27 is a pair of levers 36 and 37 pivotally connected together as shown. The lever 37 is provided with an arm 39 which rests upon the upper surface of the switch device 31, while the lever 36 is provided with a similar arm 40 which extends into the path of another finger 41 provided on the spindle of the valve or cock. In the normal position of the valve as shown in Figure 5, that is to say 30 in the position in which the valve is closed, and the switch device is in the full line position the finger 39 rests upon the upper surface of the switch device 31. When however the handle of the valve is moved in the direction of the arrow Figure 5 the finger 35 moves out of contact with the switch device 31 permitting the spring 33 to close the electric circuit. In this position the levers 36 and 37 are moved into the dotted line position shown in Figure 7. If the handle 30 is moved into its extreme position as shown in Figure 7 the arm 41 engages the finger 40 and moves the levers 36 and 37 into the full line position. This movement causes the finger 39 to depress the switch device 31 into a position in which the electric circuit is opened thus permitting a flow of cold water through the heating 50 device.

In order to avoid any electrification of the water due to its contact with the electric heating elements it is preferred to arrange the pipe line 28 connecting the device with the main water supply so that each part of the pipe line is in electric contact so that the water flowing through the device may be earthed. If, however, it is not possible to maintain 60 each part of the pipe line in electrical contact due for example to the provision of washers or the like a separate earth connection may be made.

Instead of making the two plates 6 and 65 7 of rectangular form as shown they may

be of any other convenient shape such as circular or of oval form. Furthermore, although in the specific embodiment of the invention described two plates are employed it is to be understood that the invention is not to be limited to such a construction as in some cases it may be found that only one plate is desirable and that only an electric heating element is necessary. Alternatively more than two plates may be used it being desirable however that the plates be so constructed as to provide an even number of passageways or channels to enable the water to enter and leave the device through the medium of the oppositely disposed bosses 9.

Instead of causing the device 31 to be tilted by means of the finger 35 a suitable connection may be made between the handle 30 or an associated part of the device 31 the connection having a certain amount of lost motion so as to enable the water to be turned on before the electric circuit is closed and to enable the electric circuit to be opened before flow of water ceases. Instead of employing two mercury gravity switches the positive side may be controlled by a mercury switch while the negative side may be opened and closed by means of a suitable contact switch for example comprising a movable brush and a fixed brush. In such a construction it is preferred that the positive side be opened first when the cock is turned off so that any sparking that may occur arises in the mercury switch and not between the brushes of the contact switch.

By the employment of the construction 105 according to the invention it is possible to obtain a practically instantaneous supply of hot water. Due to the switching arrangement the water must flow through the device before the current is supplied 110 to the heating element thereby avoiding overheating of the latter and consequent damage to the plates.

An electric water heater has been proposed comprising a disc of insulating 115 material having sinuous grooves on both faces and having resistance wires arranged therein the size of the disc being such as to substantially fill a space in the interior of a housing so that water could only flow over the disc in a very thin film so as to flush against the resistance wires. Electric water heaters have also been proposed in which the heating elements 120 comprised cylindrical bodies having resistance wires arranged either in helical grooves of the outer surface of the bodies or in an annular system of channels in both cases the water to be heated flowed 125 along the grooves or channels.

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Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. An electric water heating device comprising a substantially flat plate having a tortuous or elongated passageway or channel providing a relatively long path in which water is adapted to flow and an electric heating element arranged in said passageway and freely exposed to the water flowing therein. 60

2. An electric water heating device as in claim 1, wherein the tortuous or elongated passageway is formed in a plate of electric insulating material. 65

3. An electric water heating device as in claim 2, wherein two (or more) of said plates are provided each having a tortuous or elongated passageway the two plates being suitably clamped together, means being provided for separating the passageway in one plate from the passageway in the other plate. 70

4. An electric water heating device as in claim 3, wherein said means include a sheet of flexible material such as rubber and a sheet of inflexible material. 75

5. An electric water heating device as in claim 3 or 4, wherein the passageways in the two plates are so arranged that water can flow into one plate along the passageway to about the centre of the plate from whence it passes to the centre of the other plate and then along the passageway in that plate to an outlet opening. 80

6. An electric water heating device as in claim 3, 4 or 5, wherein the two plates are provided with bosses adapted to register with one another and adapted to receive a plug or connecting member so constructed as to permit water to flow through the connecting member into one plate and out of the connecting member from the other plate. 85

7. An electric water heating device as in any of the preceding claims 2 to 6, wherein two spaced electric heating elements are provided in each plate. 90

8. An electric water heating device as in claim 7, wherein means are provided for supplying electric current to the electric heating elements in each plate at two points along their lengths. 95

9. An electric water heating device as in any of the preceding claims, wherein

a valve or cock is provided for controlling the flow of water to the electric heating device, the valve or cock being so associated with a switch device that water passes through the said passageway or ways before the electric current circuit to the heating element or elements is closed and the electric circuit is opened before the flow of water ceases. 100

10. An electric water heating device as in claim 9, wherein the switch device includes a switch operable by a pivoting or tilting movement. 105

11. An electric water heating device as in claim 10, wherein the switch device includes a gravity controlled mercury switch that is normally held in a position to open the circuit, the manipulating handle of the valve or cock being associated with means for causing operation of the switch device when the valve or cock is moved into its open position. 110

12. An electric heating device as in claim 9, 10 or 11, wherein means are provided for permitting a flow of cold water through the heating device. 115

13. An electric heating device as in claim 12, wherein said means comprises a pair of pivotally connected levers, one of which co-operates with the said switch device while the other co-operates with means associated with the valve or cock, the arrangement being such that upon a further movement of the valve or cock in its open position the switch device is operated to open the circuit for the purpose specified. 120

14. An electric heating device as in any of the preceding claims, wherein each part of a pipe line connecting the device with the main water supply is in electric contact for the purpose specified. 125

15. An electric heating device substantially as described and as illustrated in the accompanying drawings. 130

16. A switch device for use in connection with an electric heating device as in any of the preceding claims and substantially as described or as illustrated in the accompanying drawings. 135

Dated this 16th day of October, 1931.

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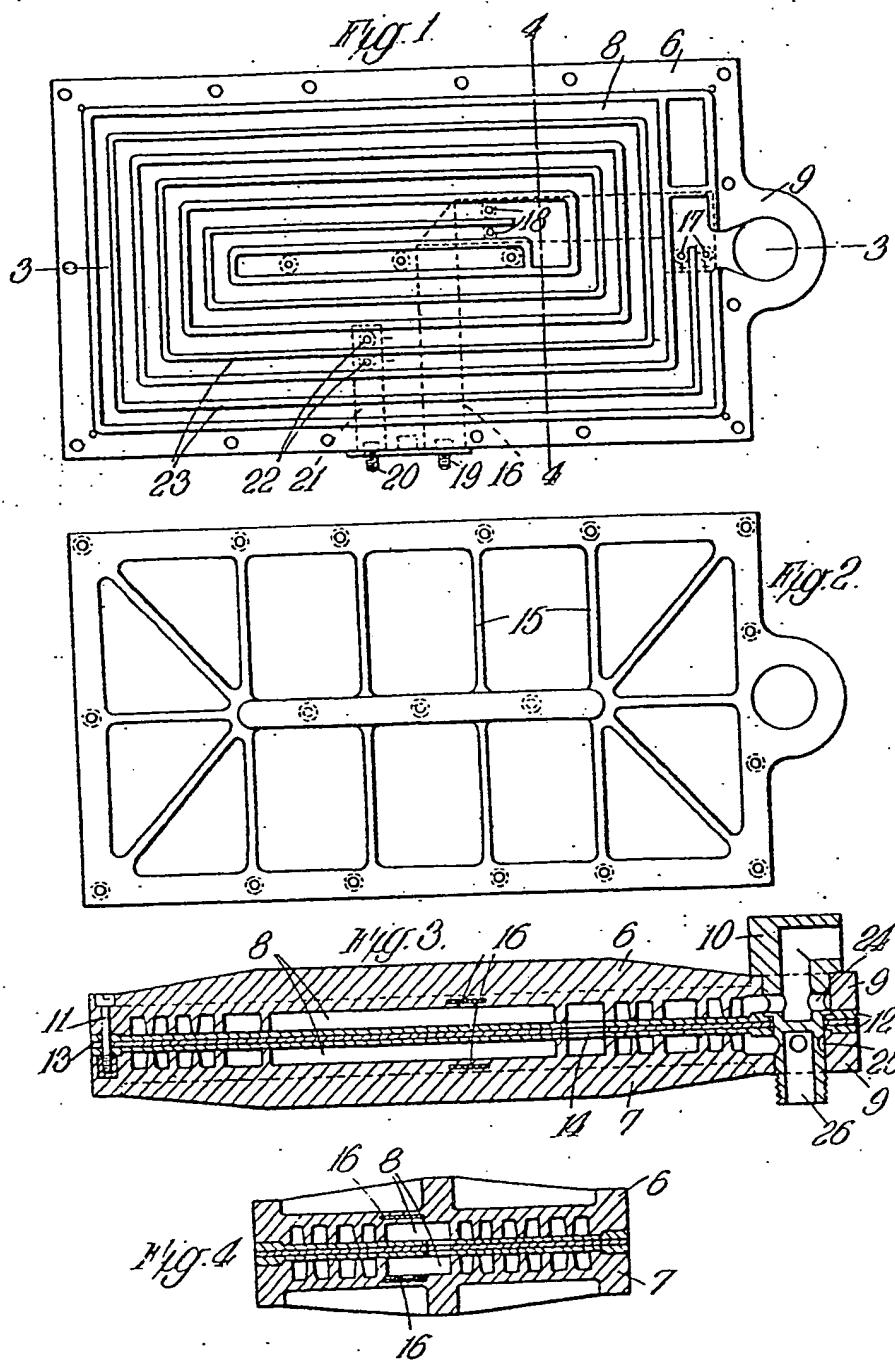
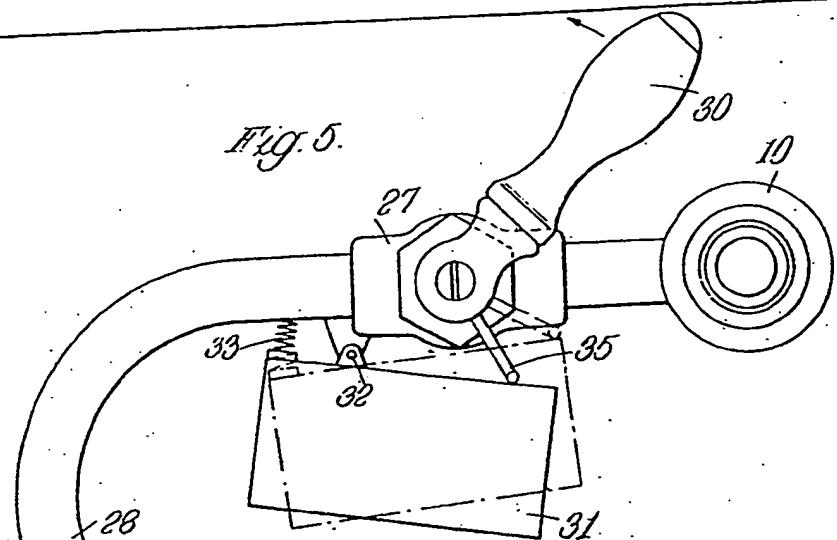


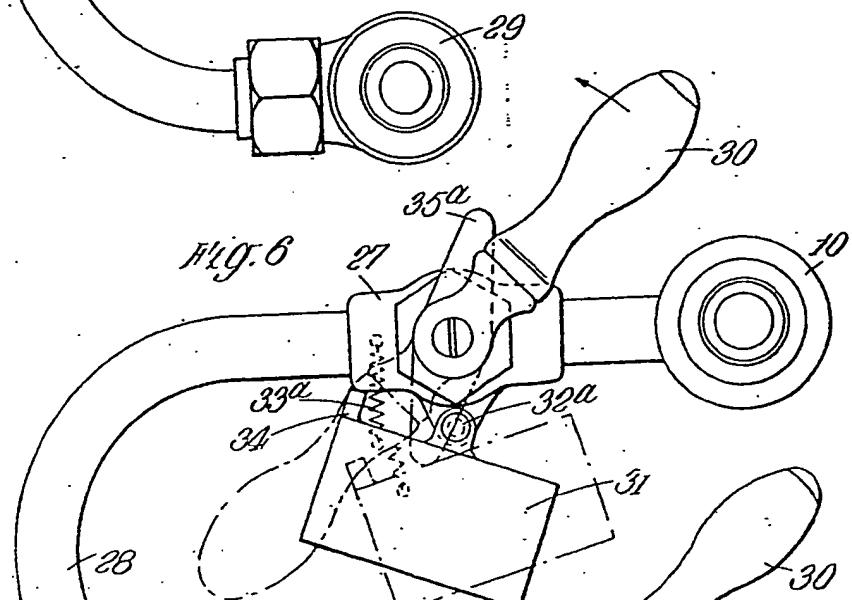
FIG. 5.



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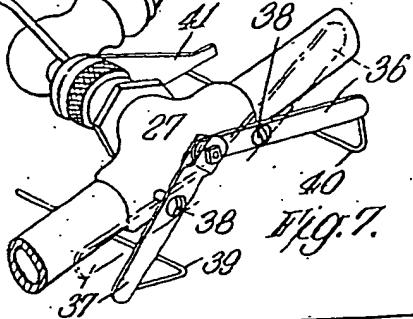
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FIG. 6

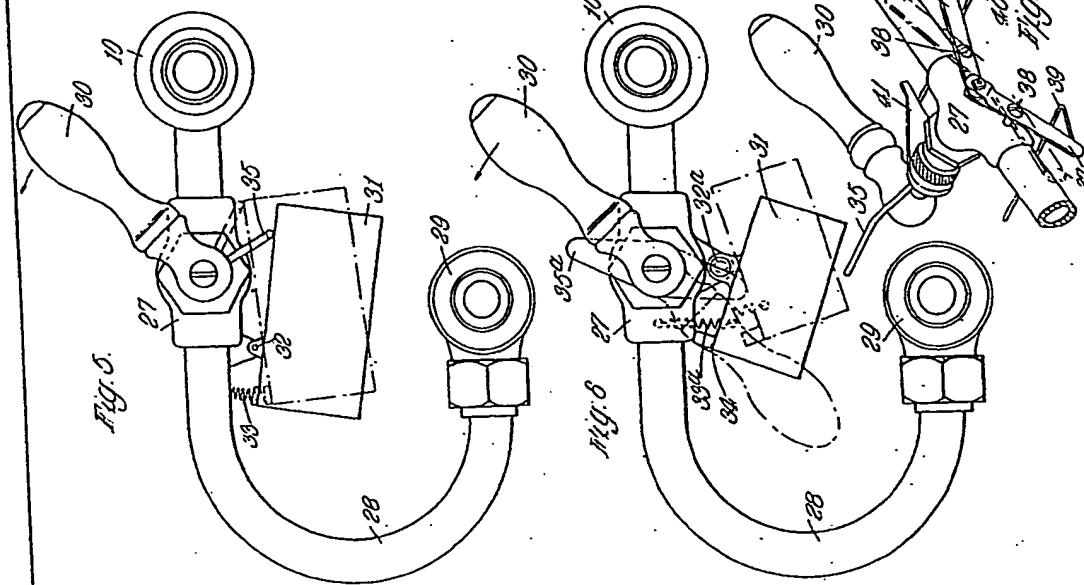


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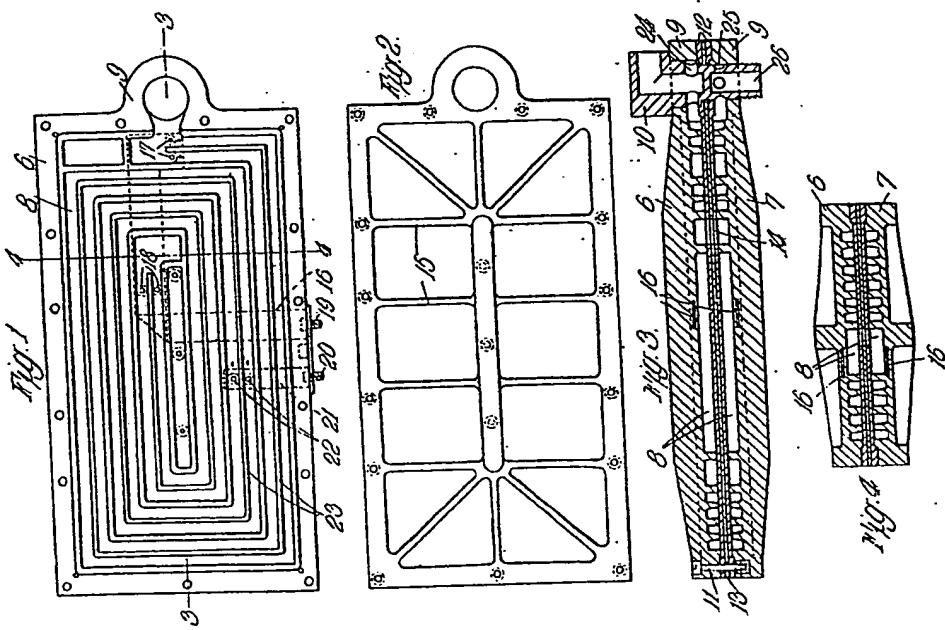
FIG. 7.



9 SHEET 9



SCHET 1



370,687 COMPLETE SPECIFICATION

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